

# **Fastener-Driving Tool Assembly**

## **Background of the Invention**

### **1. Field of the Invention**

The present invention relates to a fastener-driving tool assembly for tightening/loosening fasteners.

### **2. Description of the Related Art**

Taiwan Utility Model Publication No. 256142 discloses a hand tool including a handle having a first drive member integrally formed on an end thereof. A pivotal portion is formed on the other end of the handle. A pivotal drive device is pivotally mounted to the pivotal portion, with a second drive member being formed on an end of the pivotal drive device and with a third drive member being formed on the other end of the pivotal drive device. The first, second, and third drive members are of different sizes for selectively driving sockets of different sizes. However, the hand tool cannot be directly used to drive fasteners. Further, the handle of the hand tool is relatively long and thus could not be used in a limited space.

## **Summary of the Invention**

An object of the present invention is to provide a fastener-driving tool assembly that can be used in a limited space.

Another object of the present invention is to provide a fastener-driving tool assembly that can be directly used to drive fasteners.

In accordance with one aspect of the invention, the fastener-driving tool assembly includes a fastener-driving member and a coupling device. The fastener-driving member includes a first end and a second end for driving a fastener. The first end of the fastener-driving member includes a polygonal

1 opening. The coupling device includes a first member and a second member. The  
2 second member has a polygonal first end securely engaged with the polygonal  
3 opening of the fastener-driving member and a second end. The first member  
4 includes a first end for engaging with the second end of the second member and a  
5 second end. The second end of the first member includes a polygonal engaging  
6 hole for engaging with one of an extension rod, a handle, and a polygonal first  
7 end of a second member of a similarly constructed coupling device.

8 In an embodiment of the invention, means are provided for pivotally  
9 connecting the second end of the first member and the second end of the second  
10 member and for retaining the second end of the first member in a desired angular  
11 position relative to the second end of the second member. The second end of the  
12 fastener-driving member includes a pair of spaced jaws or a box end. The first  
13 member has a length that is smaller than four times of a width of the first member.  
14 Preferably, the polygonal opening of the fastener-driving member, the polygonal  
15 engaging hole of the first member, and the polygonal first end of the second  
16 member are square.

17 Other objects, advantages, and novel features of the invention will  
18 become more apparent from the following detailed description when taken in  
19 conjunction with the accompanying drawings.

#### 20 **Brief Description of the Drawings**

21 Fig. 1 is a perspective view of a fastener-driving tool assembly in  
22 accordance with the present invention.

23 Fig. 2 is an exploded perspective view of the fastener-driving tool  
24 assembly in accordance with the present invention.

25 Fig. 3 is a top view of the fastener-driving tool assembly in accordance  
26 with the present invention.

1           Fig. 4 is a side view, partly sectioned, of the fastener-driving tool  
2 assembly in accordance with the present invention.

3           Fig. 4A is a view similar to Fig. 4, wherein a push button is pressed for  
4 adjusting an angular position of a fastener-driving member relative to a coupling  
5 device of the fastener-driving tool assembly in accordance with the present  
6 invention.

7           Fig. 5 is a schematic side view illustrating operation of the  
8 fastener-driving tool assembly in accordance with the present invention in a  
9 limited space.

10          Fig. 6 is a schematic side view illustrating operation of the  
11 fastener-driving tool assembly in accordance with the present invention in another  
12 limited space.

13          Fig. 7 is a schematic view illustrating of the fastener-driving tool  
14 assembly in accordance with the present invention in a further limited space.

15          Fig. 8 is a schematic side view illustrating adjusting of the  
16 fastener-driving tool assembly in Fig. 7.

17          Fig. 9 is a perspective view of the fastener-driving tool assembly in  
18 accordance with the present invention, wherein the fastener-driving member is  
19 pivoted through 90 degrees.

20          Fig. 10 is a schematic view illustrating operation of the fastener-driving  
21 tool assembly in Fig. 9.

22          Fig. 11 is an exploded perspective view illustrating a modified  
23 embodiment of the fastener-driving tool assembly in accordance with the present  
24 invention.

## **Detailed Description of the Preferred Embodiments**

Referring to Figs. 1, 2, and 4, a fastener-driving tool assembly in accordance with the present invention generally comprises a coupling device 2 and a fastener-driving member 3 releasably mounted to the coupling device 2. As illustrated in Fig. 2, the fastener-driving member 3 includes an opening 33 in a first end thereof and a pair of jaws 31 on a second end thereof. The opening 33 of the fastener-driving member 3 is polygonal, preferably square. A cavity 330 is defined in each of four sidewalls delimiting the opening 33 of the fastener-driving member 3. An opening or space 32 is defined between the jaws 31 for receiving and thus driving a fastener such as a nut, bolt head, etc.

Still referring to Fig. 2, the coupling device 2 includes a first member 21 and a second member 22 that has a first end 226 releasably engaged in the opening 33 of the fastener-driving member 3. In this embodiment, a spring-biased ball 227 is mounted in the first end 226 of the second member 22 for coupling with one of the cavities 330 of the fastener-driving member 3. The second member 22 further includes a plurality of teeth 225 on a second end thereof. Preferably, the second end of the second member 22 is arcuate, with the teeth 225 being formed on a periphery of the second end of the second member 22 and with a pin hole 220 extending through the second end of the second member 22.

The first member 21 includes a pair of lugs 211 on a first end thereof and a polygonal (preferably square) engaging hole 213 in a second end thereof. At least one of four sidewalls delimiting the square engaging hole 213 has a cavity 213a defined therein. The lugs 211 include aligned screw holes 232 one of which has a countersink 23. A space 212 is defined between the lugs 211. A receptacle 221 is defined in a bottom wall delimiting the space 212 and includes a first section 222 distal to the lugs 211 and a second section 223 proximal to the lugs

1 223. Preferably, the first section 222 has a diameter smaller than that of the  
2 second section 223.

3 Referring to Figs. 2 and 4, an elastic element 224 and an actuating  
4 member 217 are received in the second section 223 of the receptacle 221. The  
5 actuating member 217 includes a first end 217a received in the second section 223  
6 of the receptacle 221 and a second end 217b received in the first section 222 of  
7 the receptacle 221. The first end 217a of the actuating member 217 includes a  
8 toothed portion 217c.

9 The first member 21 further includes a hole 214 in a side thereof, with a  
10 bore 216 being defined in a bottom wall 215 delimiting the hole 214 and  
11 communicated with the first section 222 of the receptacle 221. An elastic element  
12 219 is mounted in the hole 214 of the first member 21. Further, a push button 218  
13 includes an enlarged head 218a and a shank 218b extending from the enlarged  
14 head 218a. The enlarged head 218a is located outside the first member 21 for  
15 manual operation. The shank 218b extends through the hole 214 of the first  
16 member 21 into the bore 216 of the first member 21, with the elastic element 219  
17 being mounted around the shank 218b, best shown in Fig. 4. The shank 218b of  
18 the push button 218 includes a first recessed portion 218c and a second recessed  
19 portion 218d in an outer periphery thereof. The second recessed portion 218d is  
20 preferably inclined and contiguous to the first recessed portion 218c that is deeper  
21 than the second recessed portion 218d. The second recessed portion 218d is  
22 biased by the elastic element 219 toward the second end 217b of the actuating  
23 member 217.

24 In assembly, a pin 23 is extended through the pin holes 232 of the lugs  
25 211 of the first member 21 and the pin hole 220 of the second member 22, with a  
26 head 233 of the pin 23 being received in the countersink 231 of the first member

1 22. Preferably, the first member 21 has a length L smaller than four times of a  
2 width W of the first member 211 (i.e.,  $L < 4W$ ). Thus, the first member 21 can be  
3 used in a limited space.

4 The fastener-driving member 3 in Fig. 4 is retained in an angular position  
5 relative to the coupling device 2. It is noted that the second recessed portion 218d  
6 presses against the second end 217b of the actuating member 217 under the action  
7 of the elastic element 219, thereby urging and the toothed portion 217c of the  
8 actuating member 217 to engage with the teeth 225 of the second member 22.

9 When adjustment of the angular position of the fastener-driving member 3  
10 relative to the coupling device 2 is required, the enlarged end 218a of the push  
11 button 218 is pushed, which causes sliding movement of the shank 218b in the  
12 hole 214 and the bore 216 of the first member 21. As illustrated in Fig. 4A, the  
13 second end 217b of the actuating member 217 is disengaged from the second  
14 recessed portion 218d of the shank 218b of the push button 218 to a position  
15 aligned with the first recessed portion 218c that is deeper than the second recessed  
16 portion 218d, allowing the second member 22 and the fastener-driving member 3  
17 to pivot relative to the first member 21. The push button 218 is released when the  
18 fastener-driving member 3 reaches the desired angular position relative to the first  
19 member 21, and the fastener-driving member 3 is again retained in place.

20 Fig. 5 illustrates the operation of the fastener-driving tool assembly in  
21 accordance with the present invention in a limited space. The jaws 32 of the first  
22 member 3 are engaged with a fastener 5. A handle or extension rod 7 has an end  
23 releasably coupled in the polygonal engaging hole 213 of the first member 21,  
24 and the user may grip the other end of the extension rod 7 for  
25 tightening/loosening a fastener 5 located in a difficult-to-operate position. The end  
26 of the extension rod 7 may include a spring-biased ball 71 mounted therein, with

1 the spring-biased ball 71 being releasably engaged in one of the cavities 213a of  
2 the first member 21.

3 Fig. 6 is a schematic side view illustrating operation of the  
4 fastener-driving tool assembly in accordance with the present invention in another  
5 limited space. As mentioned above, the fastener-driving member 3 and the second  
6 member 22 can be adjusted to a desired angular position of relative to the first  
7 member 21. Again, the jaws 32 of the first member 3 are engaged with a fastener  
8 5. A handle or extension rod 7 has an end releasably coupled in the polygonal  
9 engaging hole 213 of the first member 21, and the user may grip the other end of  
10 the extension rod 7 for tightening/loosening a fastener 5 located in a  
11 difficult-to-operate position.

12 Fig. 7 is a schematic view illustrating of the fastener-driving tool  
13 assembly in accordance with the present invention in a further limited space. An  
14 additional coupling device 2' can be provided in a case for driving a fastener 6  
15 located in a limited space having a relatively large depth. The jaws 32 of the first  
16 member 3 of the coupling device 2 are engaged with the fastener 6. The second  
17 member 22 of the additional coupling device 2' is coupled in the polygonal  
18 engaging hole 213 of the coupling device 2. A handle or extension rod 7 has an  
19 end releasably coupled in the polygonal engaging hole 213 of the first member 21  
20 of the additional coupling device 2', and the user may grip the other end of the  
21 extension rod 7 for tightening/loosening the fastener 6 located in a  
22 difficult-to-operate position. Fig. 8 is a schematic side view illustrating adjusting  
23 of the fastener-driving tool assembly in Fig. 7. The angular position of the  
24 fastener-driving member 3 and the second member 2 of the coupling device 2 can  
25 be adjusted relative to the first member 21 of the coupling device 2, and the  
26 angular position of the handle or extension rod 7 and the first member 21 of the

1 additional coupling device 2' can be adjusted relative to the second member 22 of  
2 the additional coupling device 2'.

3 Fig. 9 is a perspective view of fastener-driving tool assembly in  
4 accordance with the present invention, wherein the fastener-driving member is  
5 pivoted through 90 degrees. Fig. 10 is a schematic view illustrating operation of  
6 the fastener-driving tool assembly in Fig. 9. A fastener 8 located in a  
7 difficult-to-drive position can be easily tightened/loosened by the fastener-driving  
8 tool assembly in accordance with the present invention.

9 It is noted that the jaws 32 of the fastener-driving member 3 can be  
10 replaced by any other suitable faster-driving element, such as a ring or box end 34  
11 (Fig. 11) allowing or not allowing reversible ratcheting operations.

12 The fastener-driving tool assembly 1 in accordance with the present  
13 invention allows the user to operate the handle or extension rod 7 at a level  
14 different from that of the fastener 3.

15 Although the invention has been explained in relation to its preferred  
16 embodiment, it is to be understood that many other possible modifications and  
17 variations can be made without departing from the scope of the invention as  
18 hereinafter claimed.